Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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6689169173

PHYSICS **9702/33**

Paper 3 Advanced Practical Skills 1 **October/November 2018**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
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DO **NOT** WRITE IN ANY BARCODES.

Answer **both** questions.
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Additional answer paper and graph paper should be used only if it becomes necessary to do so.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

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You may not need to use all of the materials provided.

1 In this experiment, you will investigate an electrical circuit.

(a)
- Place the 15 Ω resistor in component holder P.
- Place the 22 Ω resistor in component holder Q.
- Set up the circuit shown in Fig. 1.1.

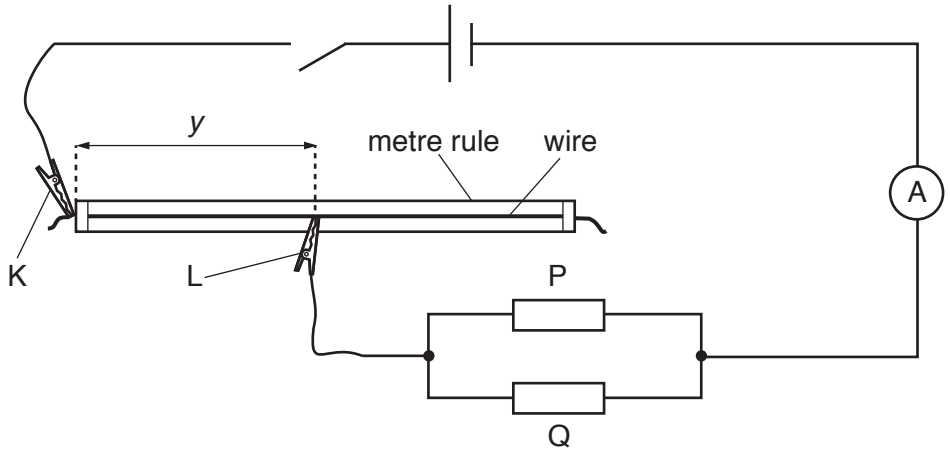


Fig. 1.1

- K and L are crocodile clips.

  The resistors in the component holders have resistances *P* and *Q*.

  Place L approximately half-way along the wire.
- The distance between K and L is *y* as shown in Fig. 1.1.

  Record *P*, *Q* and *y*.

P = ...

Q = ...

y = ...

- Close the switch.
- Record the ammeter reading *I*.

I = ...

- Open the switch.

[1]

(b) • Change one or both of the resistors in P and Q.

• Record the new values of P and Q.

P = ...

Q = ...

• Close the switch.

• Change the position of L on the wire so that the ammeter reading is as close as possible to the value for I in **(a)**.

• Record y.

y = ...

• Open the switch.

[1]

(c) Repeat **(b)** until you have six sets of readings of P, Q and y. Include your readings from **(a)** and **(b)**.

Record your results in a table. Include values of $\frac{PQ}{P+Q}$ in your table.

[9]

(d) **(i)** Plot a graph of y on the y-axis against $\frac{PQ}{P+Q}$ on the x-axis. [3]

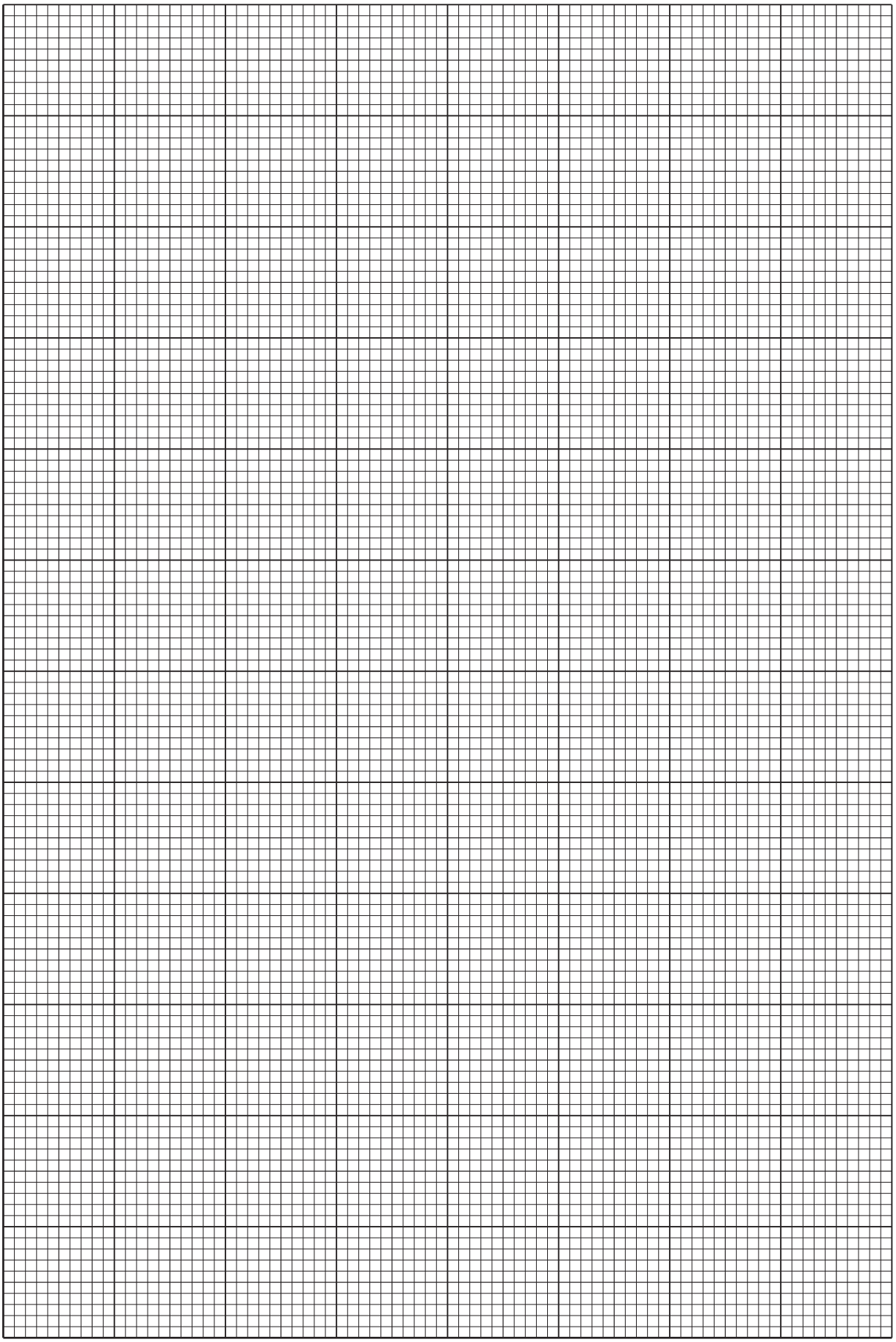
(ii) Draw the straight line of best fit. [1]

(iii) Determine the gradient and y-intercept of this line.

gradient = ...

y-intercept = ...

[2]



(e) It is suggested that the quantities y, P and Q are related by the equation

$$y = -\frac{MPQ}{P+Q} + N$$

where M and N are constants.

Using your answers in **(d)(iii)**, determine values for M and N.
Give appropriate units.

$M =$ .....

$N =$ .....
[2]

(f) Theory suggests that

$$\frac{N}{M} = \frac{E}{I}$$

where E is the electromotive force (e.m.f.) of the cell.

Calculate E. Give an appropriate unit.

$E =$ .....[1]

[Total: 20]

You may not need to use all of the materials provided.

2 In this experiment, you will investigate the equilibrium of a system of three identical springs.

(a) You have been provided with three springs attached to a ring.

Measure and record the unstretched length S of the coiled section of one of the springs, as shown in Fig. 2.1.

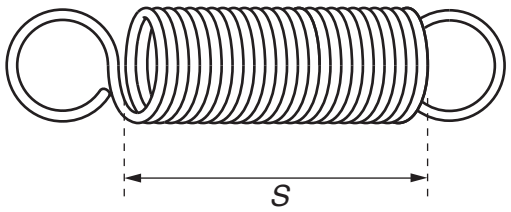


Fig. 2.1

S = ...[1]

(b) (i) • Set up the apparatus as shown in Fig. 2.2.

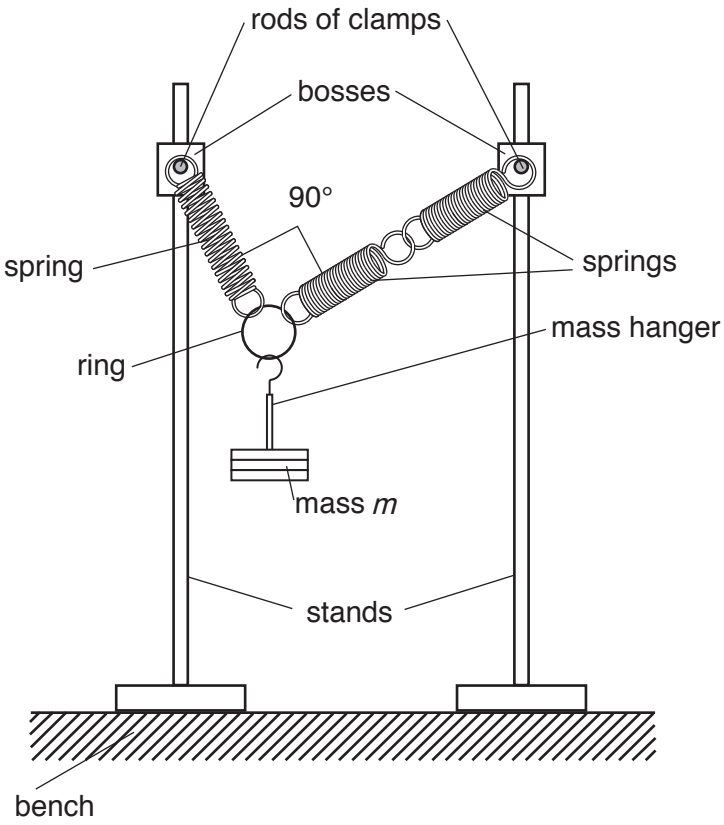


Fig. 2.2

- The total mass *m* of the mass hanger and the slotted masses should be 0.300 kg.
- Adjust the position of the bosses so that the centres of the rods of the clamps are at the same height above the bench.
- Change the separation of the stands until the angle between the springs is 90°.

- The lengths S_1 and S_2 of the coiled sections of the two springs attached to the ring are shown in Fig. 2.3.

  The angle between the single spring and the vertical is θ.

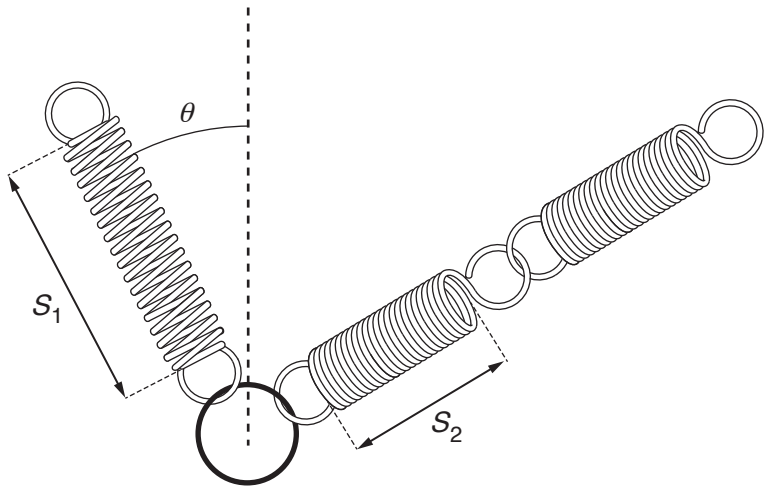


Fig. 2.3

Measure and record m, S_1, S_2 and θ.

m = ... kg

S_1 = ...

S_2 = ...

θ = ... °

[2]

(ii) Estimate the percentage uncertainty in your value of θ.

percentage uncertainty = ...[1]

(iii) Calculate $e_1 \cos\theta$ and $e_2 \sin\theta$ where

$$e_1 = S_1 - S \quad \text{and} \quad e_2 = S_2 - S.$$

$e_1 \cos\theta =$ .....

$e_2 \sin\theta =$ .....
[1]

(iv) Justify the number of significant figures that you have given for your value of $e_1 \cos\theta$.

.....

.....

.....[1]

(c) Change m to 0.600 kg and repeat **(b)(i)** and **(b)(iii)**.

$m =$ ..... kg

$S_1 =$ .....

$S_2 =$ .....

$\theta =$ ..... °

$e_1 \cos\theta =$ .....

$e_2 \sin\theta =$ .....
[3]

(d) It is suggested that the relationship between e_1, e_2, θ and m is

$$e_1 \cos\theta + e_2 \sin\theta = \beta m$$

where β is a constant.

(i) Using your data, calculate two values of β.

first value of β = ...

second value of β = ...
[1]

(ii) Explain whether your results support the suggested relationship.

.....

.....

.....

.....[1]

(e) Theory suggests that

$$\beta = \frac{g}{k}$$

where the acceleration of free fall g is 9.81 m s^{-2} and k is the spring constant of a spring.

Using your second value of β, calculate k. Give an appropriate unit.

k = ...[1]

(f) **(i)** Describe four sources of uncertainty or limitations of the procedure for this experiment.

1. .....

.....

2. .....

.....

3. .....

.....

4. .....

.....

[4]

(ii) Describe four improvements that could be made to this experiment. You may suggest the use of other apparatus or different procedures.

1. .....

.....

2. .....

.....

3. .....

.....

4. .....

.....

[4]

[Total: 20]

Cambridge International AS & A Level

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CANDIDATE NUMBER | | | | |

5190685876

PHYSICS **9702/34**

Paper 3 Advanced Practical Skills 2 **October/November 2018**

2 hours

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[Turn over

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1 In this experiment, you will investigate an electrical circuit.

(a) • You have been provided with the circuit shown in Fig. 1.1.

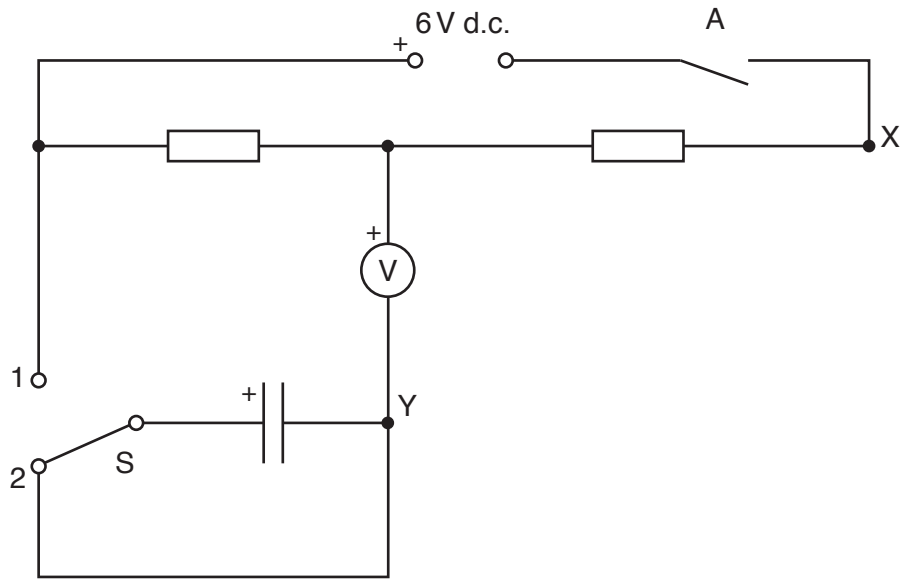


Fig. 1.1

- Select one of the groups of parallel resistors and connect it in the component holder.
- Connect the resistor R and the component holder in series between X and Y to complete the circuit shown in Fig. 1.2.

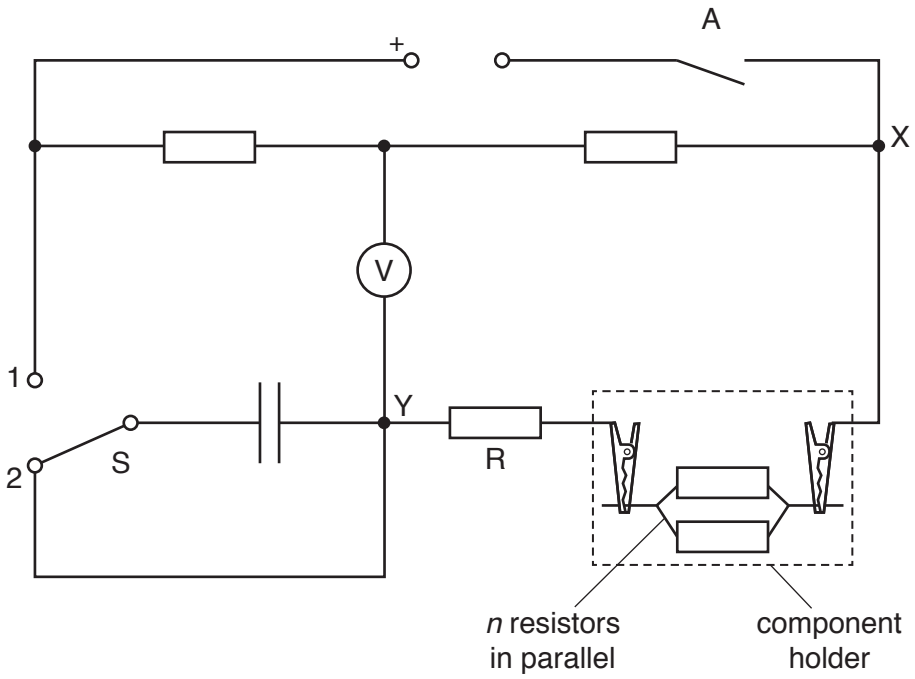


Fig. 1.2

- Ensure that switch S is in position 2.

- Record the number n of parallel resistors in the component holder.

$n =$ .....

- Close switch A.
- Record the voltmeter reading V.

$V =$ .....

- Open A.

[1]

(b)
- Close A.
- Move S to position 1 and start the stopwatch. The voltmeter reading will immediately become negative and then gradually increase.
- Stop the stopwatch as soon as the voltmeter reading passes zero and becomes positive.
- Record the time t as shown by the stopwatch.

$t =$ .....

- Move S to position 2.
- Open A.

[2]

(c) By using different groups of resistors, change n and repeat **(b)** until you have six sets of values of n and t.

Record your results in a table. Include values of $\frac{1}{n}$ in your table.

[9]

(d) **(i)** Plot a graph of t on the y-axis against $\frac{1}{n}$ on the x-axis. [3]

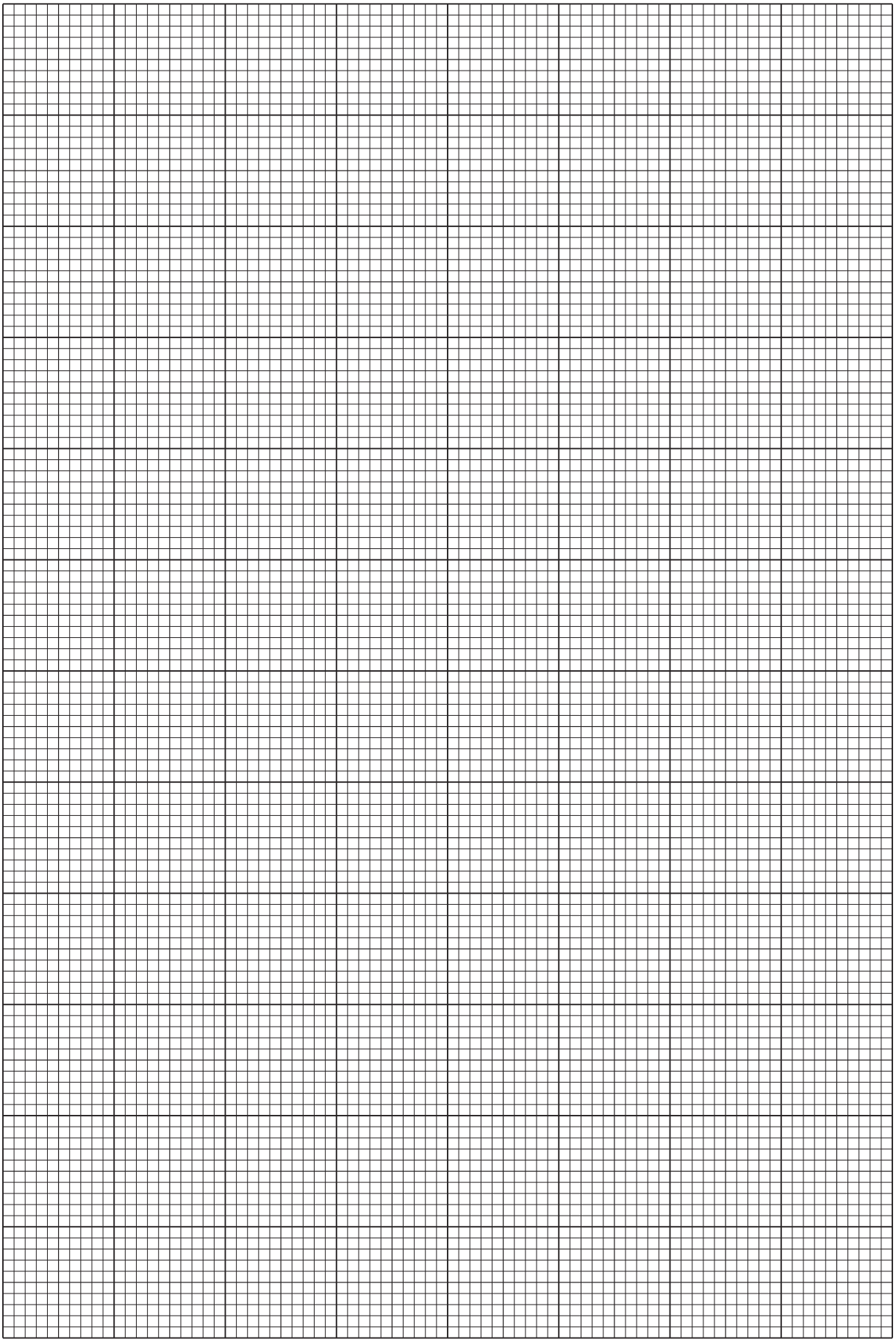
(ii) Draw the straight line of best fit. [1]

(iii) Determine the gradient and y-intercept of this line.

gradient = ...

y-intercept = ...

[2]



(e) It is suggested that the quantities t and n are related by the equation

$$t = \frac{a}{n} + b$$

where a and b are constants.

Use your answers in **(d)(iii)** to determine the values of a and b.
Give appropriate units.

a = ...

b = ...
[2]

[Total: 20]

You may not need to use all of the materials provided.

2 In this experiment, you will investigate the rolling of a sphere along tracks of different widths.

(a) (i) Measure and record the diameter d of the sphere.

d = ...[1]

(ii) • Measure and record the width w of the narrower track, as shown in Fig. 2.1.

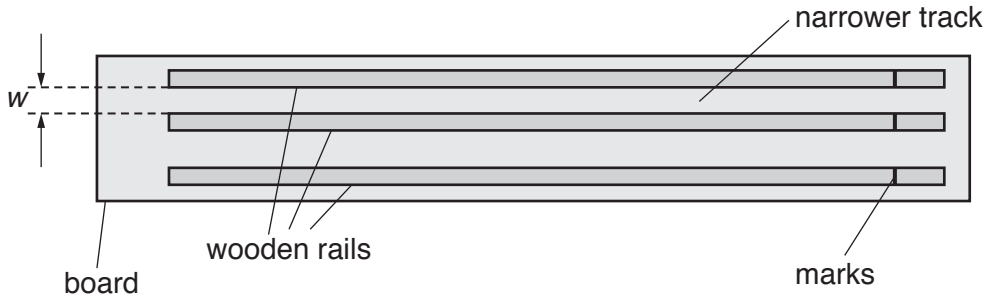


Fig. 2.1 (not to scale)

w = ...

• Calculate D^2 where $D^2 = d^2 - w^2$.

D^2 = ...
[1]

(b) (i) • Place the board on the bench. Raise the end of the board with the marks by resting it on a wooden block. Place the other wooden block across the lower end of the board, as shown in Fig. 2.2.
Secure the blocks in position with small pieces of Blu-Tack.

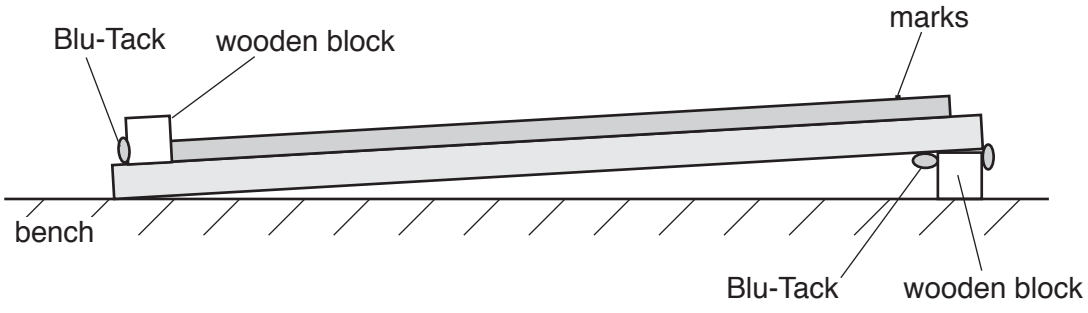


Fig. 2.2 (not to scale)

- Measure and record the distance x from the wooden block at the lower end of the board to the mark on the middle rail, as shown in Fig. 2.3.

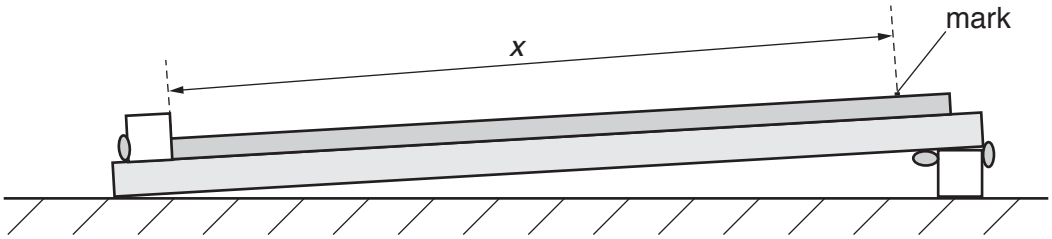


Fig 2.3 (not to scale)

x = ...[1]

(ii) • Place the sphere on the narrower track at the position shown in Fig. 2.4.

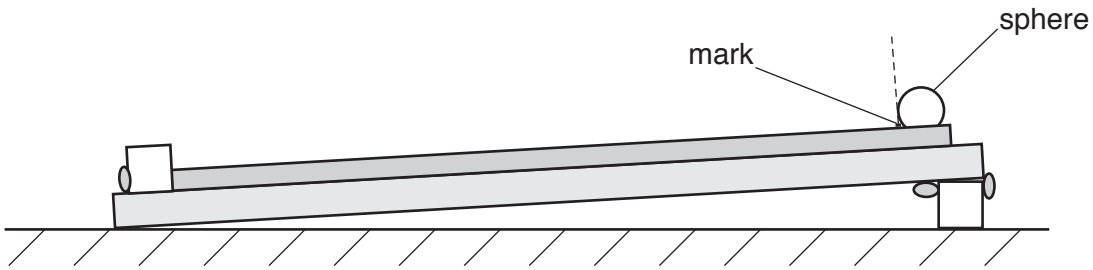


Fig. 2.4 (not to scale)

- Release the sphere.
- Measure and record the time t for the sphere to roll down to the lower wooden block.

t = ...[1]

(iii) Estimate the percentage uncertainty in your value of t.

percentage uncertainty = ...[1]

(iv) Calculate the final speed v of the sphere, using

$$v = \frac{2x}{t}.$$

$v =$ .....[1]

(v) Justify the number of significant figures you have given for your value of v.

.....

.....

.....[1]

(c) Repeat **(a)(ii)**, **(b)(ii)** and **(b)(iv)** using the **wider** of the two tracks.

$w =$ .....

$D^2 =$ .....

$t =$ .....

$v =$ .....
[3]

(d) It is suggested that the relationship between v, d and D is

$$k = v^2\left(10 + \frac{d^2}{D^2}\right)$$

where k is a constant.

(i) Using your data, calculate two values of k.

first value of k = ...

second value of k = ...
[1]

(ii) Explain whether your results support the suggested relationship.

.....

.....

.....

.....[1]

(e) (i) Describe four sources of uncertainty or limitations of the procedure for this experiment.

1. .....

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2. .....

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3. .....

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4. .....

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[4]

(ii) Describe four improvements that could be made to this experiment. You may suggest the use of other apparatus or different procedures.

1. .....

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3. .....

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4. .....

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[4]

[Total: 20]

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CANDIDATE NAME

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9212440494

PHYSICS **9702/35**

Paper 3 Advanced Practical Skills 1 **October/November 2018**

2 hours

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You may not need to use all of the materials provided.

1 In this experiment, you will investigate the extension of a spring.

(a) You have been provided with a spring.

- Measure and record the length x_0 of the unstretched coiled section of the spring, as shown in Fig. 1.1.

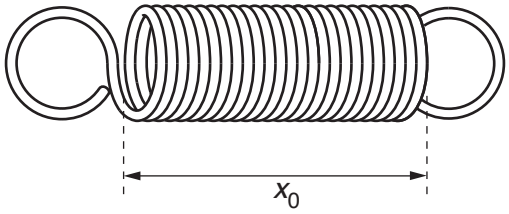


Fig. 1.1

x_0 = ...[1]

(b) • Set up the apparatus as shown in Fig. 1.2.

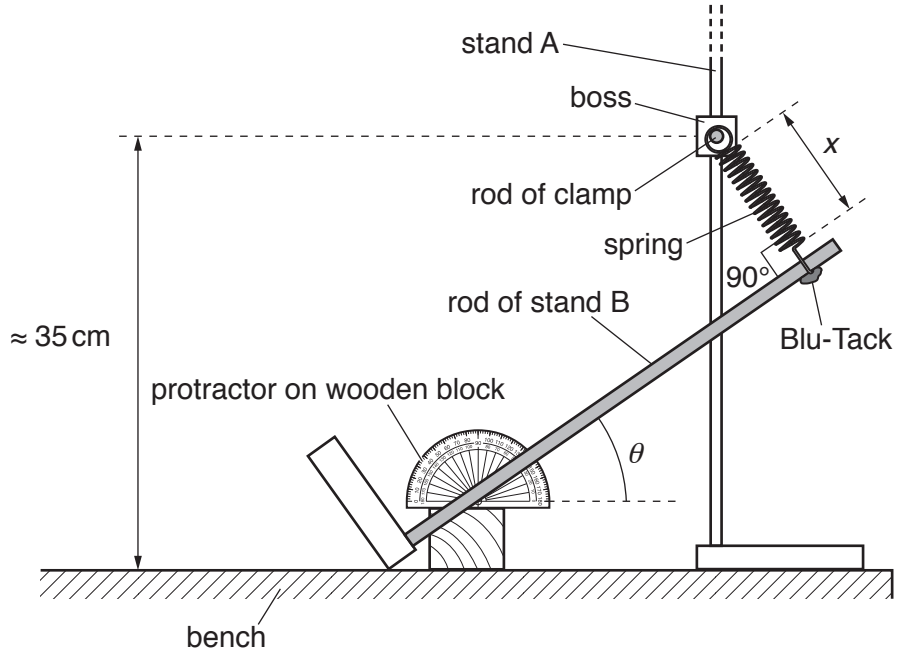


Fig. 1.2

The protractor should be attached to the wooden block using some of the Blu-Tack.

The height of the rod of the clamp above the bench should be approximately 35 cm.

One loop of the spring should be around the rod of the clamp.

The other loop of the spring should be around the rod of stand B close to the top of the rod and secured using Blu-Tack.

- Slide the base of stand B until the angle between the rod of stand B and the stretched spring is 90°.

- The length of the coiled section of the spring is x.
  The angle between the rod of stand B and the horizontal is θ.

  Measure and record x and θ.

  x = ...

  θ = ...

- Calculate e where

  $$e = (x - x_0).$$

  e = ...
  [1]

(c) Change the height of the boss. Slide the base of stand B until the angle between the rod of stand B and the stretched spring is again 90°.
Measure and record x and θ. Repeat until you have six sets of values.

Record your results in a table. Include values of e, $\frac{e}{\cos\theta}$ and $\tan\theta$ in your table.

[10]

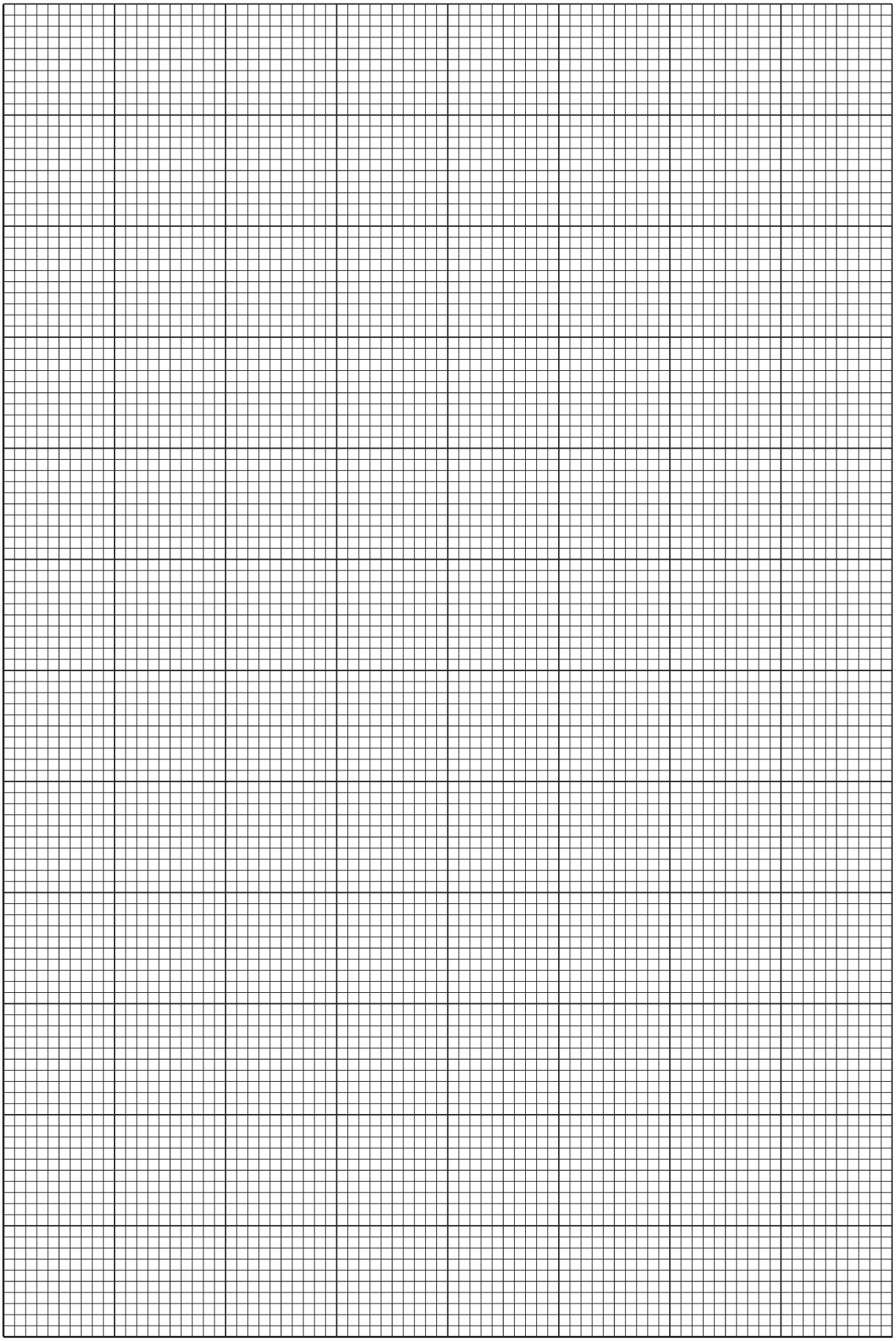
(d) **(i)** Plot a graph of $\frac{e}{\cos\theta}$ on the y-axis against $\tan\theta$ on the x-axis. [3]

(ii) Draw the straight line of best fit. [1]

(iii) Determine the gradient and y-intercept of this line.

gradient = ...

y-intercept = ...
[2]



(e) It is suggested that the quantities e and θ are related by the equation

$$\frac{e}{\cos\theta} = N\tan\theta + M$$

where N and M are constants.

Using your answers in **(d)(iii)**, determine the values of N and M.
Give appropriate units.

N = ...

M = ...
[2]

[Total: 20]

You may not need to use all of the materials provided.

2 In this experiment, you will investigate the friction between string and a pulley.

(a) (i) You have been provided with two lengths of string.

Measure and record the diameter d of the **thicker** string.

d = ...mm [2]

(ii) Estimate the percentage uncertainty in your value of d.

percentage uncertainty = ...[1]

(iii) Calculate the cross-sectional area A of the string using

$$A = \frac{\pi d^2}{4}.$$

A = ...[1]

(iv) Justify the number of significant figures that you have given for your value of A.

.....

.....

.....[1]

(b) (i) You have been provided with two mass hangers and a pulley.

- Rotate the pulley to ensure that it rotates freely.
- Using the **thicker** string, set up the apparatus as shown in Fig. 2.1.

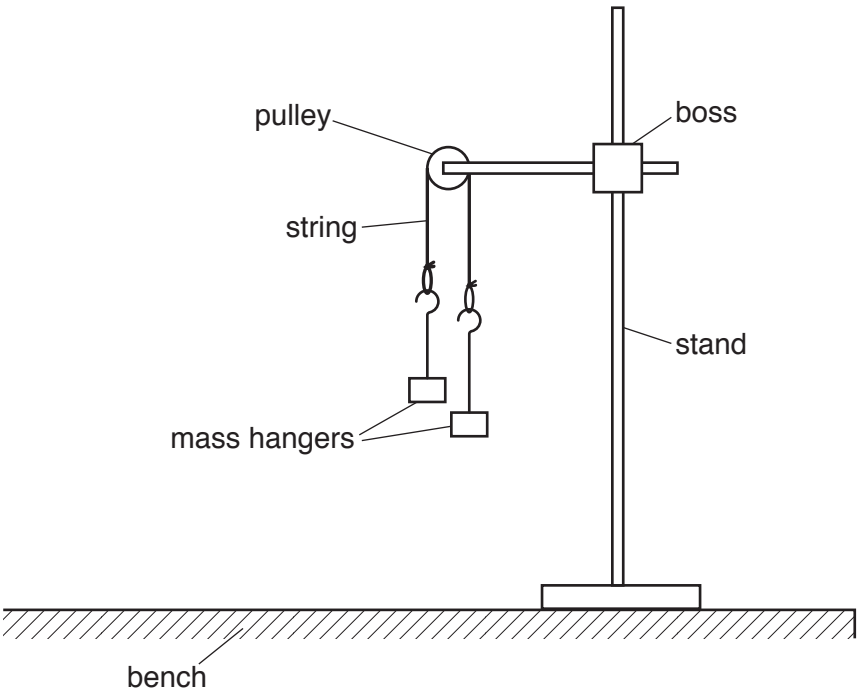


Fig. 2.1

- Add paper clips to **one** of the mass hangers until the mass hangers start to move.
- Record the number *p* of paper clips added to the mass hanger.

p = ...[1]

(ii) • Remove the paper clips from the mass hanger.

• Add paper clips to the **other** mass hanger until the mass hangers start to move.

• Record the number q of paper clips added to the mass hanger.

$q =$ .....

• Calculate $\frac{(p+q)}{2}$.

$\frac{(p+q)}{2} =$ .....
[1]

(c) Using the **thinner** string, repeat **(a)(i)**, **(a)(iii)** and **(b)**.

$d =$ ..... mm

$A =$ .....

$p =$ .....

$q =$ .....

$\frac{(p+q)}{2} =$ .....
[3]

(d) It is suggested that the relationship between p, q and A is

$$\left[\frac{(p+q)}{2}\right]^3 = kA$$

where k is a constant.

(i) Using your data, calculate two values of k.

first value of k = ...

second value of k = ...
[1]

(ii) Explain whether your results support the suggested relationship.

.....

.....

.....

.....[1]

(e) (i) Describe four sources of uncertainty or limitations of the procedure for this experiment.

1. .....

.....

2. .....

.....

3. .....

.....

4. .....

.....

[4]

(ii) Describe four improvements that could be made to this experiment. You may suggest the use of other apparatus or different procedures.

1. .....

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[4]

[Total: 20]

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CANDIDATE NAME

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6076125870

PHYSICS **9702/36**

Paper 3 Advanced Practical Skills 2 **October/November 2018**

2 hours

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1 In this experiment, you will investigate a system in equilibrium.

(a) • Assemble the apparatus as shown in Fig. 1.1.

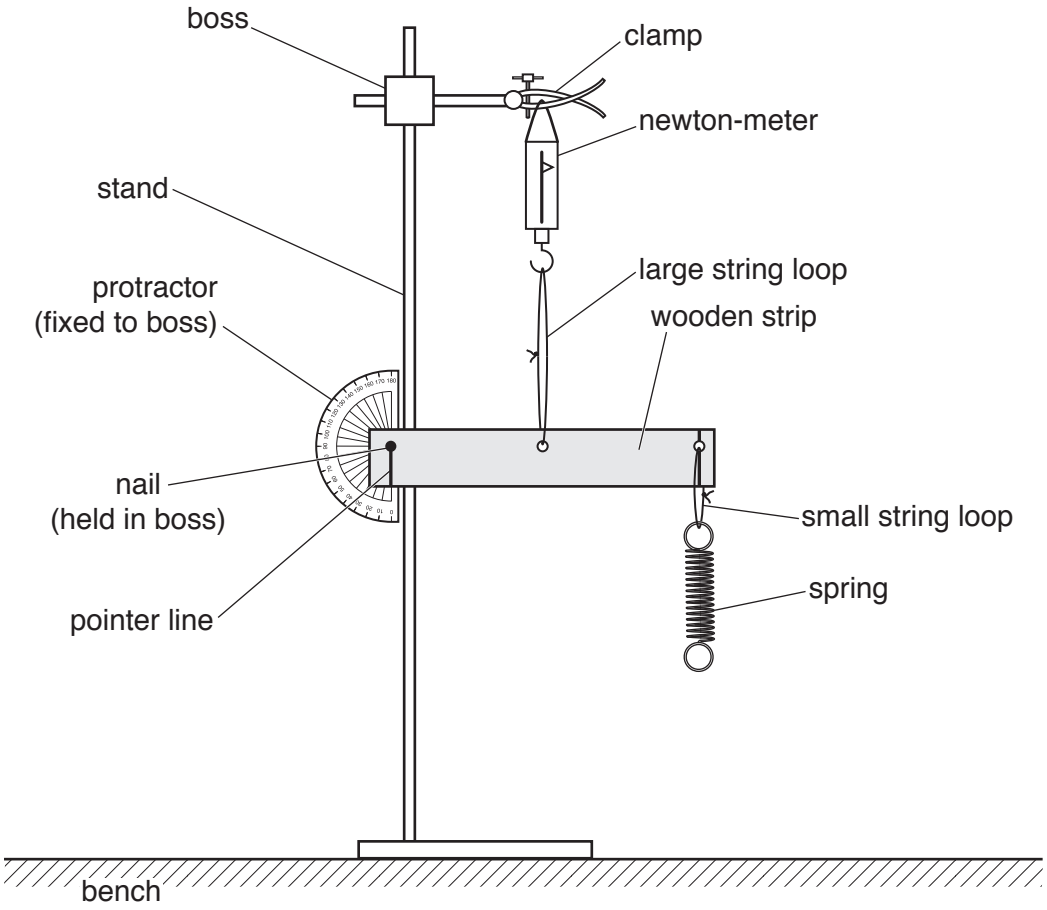


Fig. 1.1

- Adjust the apparatus so that the wooden strip is horizontal, the large string loop and newton-meter are vertical, and the pointer line is aligned with the zero line on the protractor.

- Measure and record the length L_0 of the coiled part of the spring, as shown in Fig. 1.2.

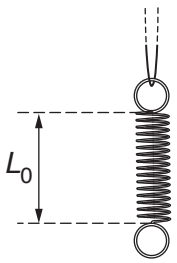


Fig. 1.2

L_0 = ... [1]

(b) • Pull the spring down a short distance, keeping the small string loop aligned with the line on the wooden strip, as shown in Fig. 1.3.

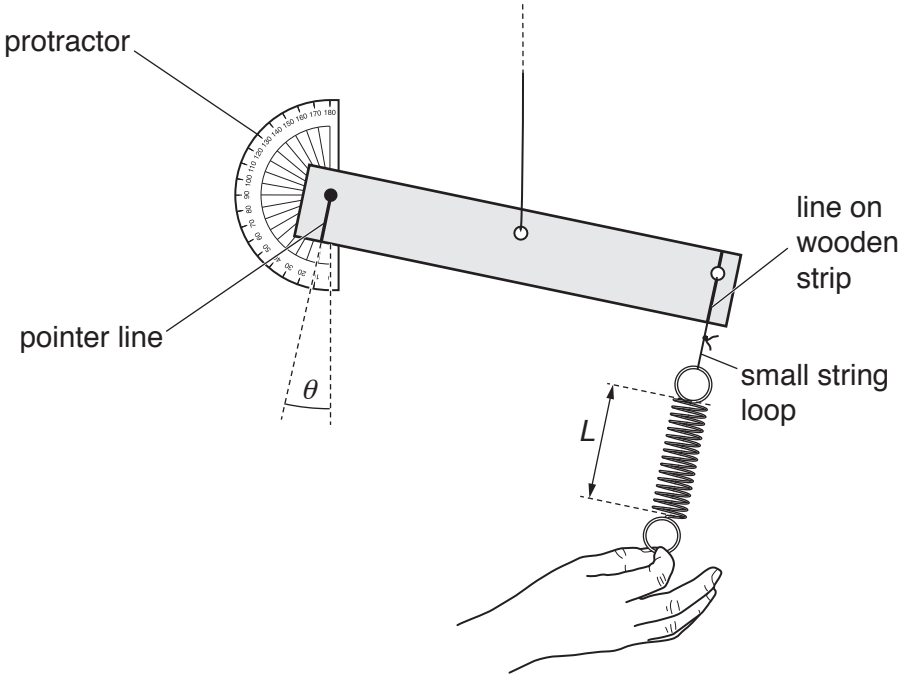


Fig. 1.3

• Measure and record the length L of the coiled section of the spring, as shown in Fig. 1.3.

L = ...

• Read and record the angle θ of the pointer line from the vertical, as shown in Fig. 1.3.

θ = ...
[1]

(c) Repeat **(b)** using different values of θ less than 45° until you have six sets of values of θ and L.

Record your results in a table. Include values of $(L-L_0)$ and values of $(\sin\theta)(\cos\theta)$ in your table.

[10]

(d) **(i)** Plot a graph of $(L-L_0)$ on the y-axis against $(\sin\theta)(\cos\theta)$ on the x-axis. [3]

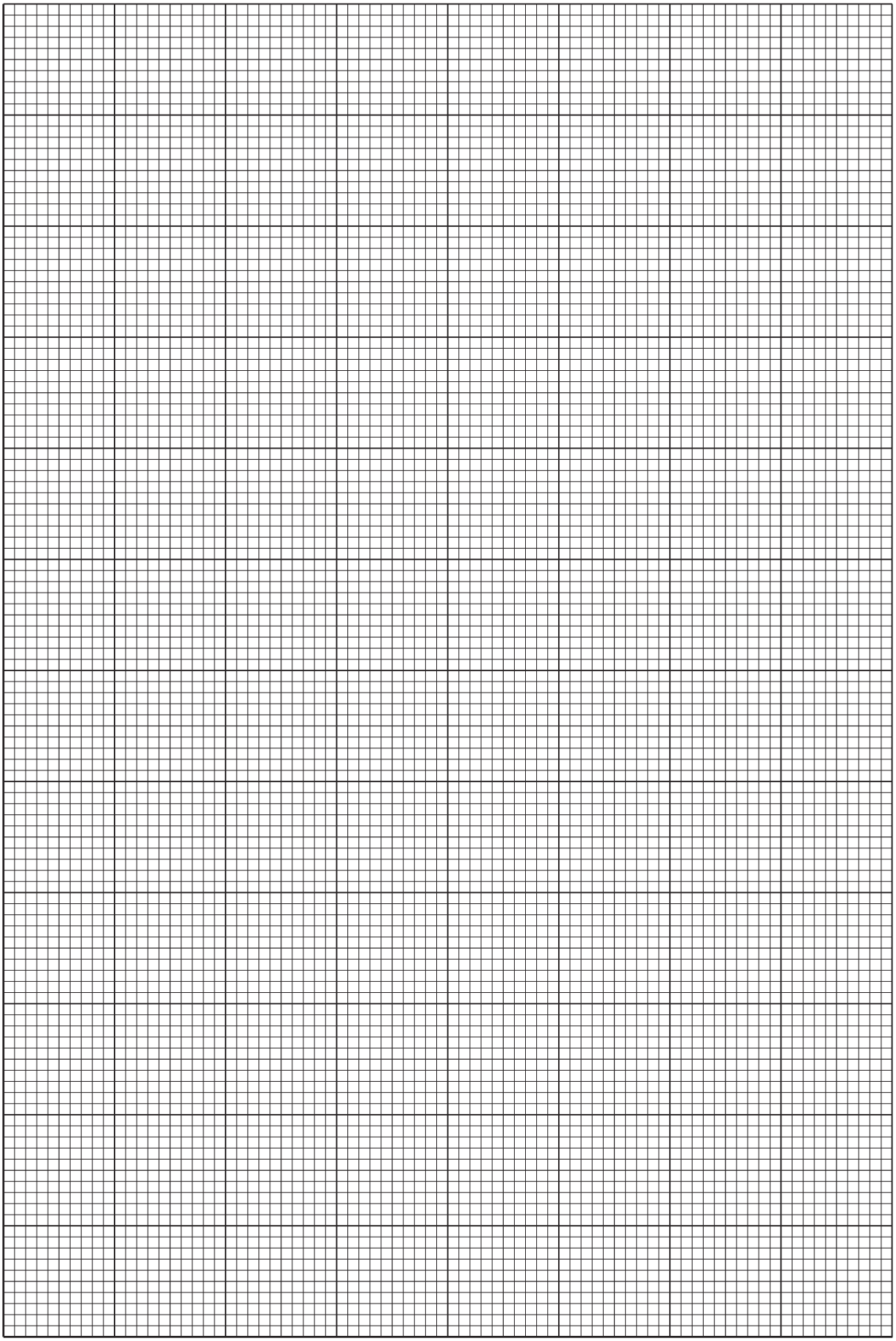
(ii) Draw the straight line of best fit. [1]

(iii) Determine the gradient and y-intercept of this line.

gradient = ...

y-intercept = ...

[2]



(e) It is suggested that the quantities L and θ are related by the equation

$$(L - L_0) = a\,(\sin\theta)(\cos\theta) + b$$

where a and b are constants.

Use your answers in **(d)(iii)** to determine the values of a and b.
Give appropriate units.

a = ...

b = ...
[2]

[Total: 20]

You may not need to use all of the materials provided.

2 In this experiment, you will investigate the motion of a hacksaw blade.

(a) • Assemble the apparatus as shown in Fig. 2.1.

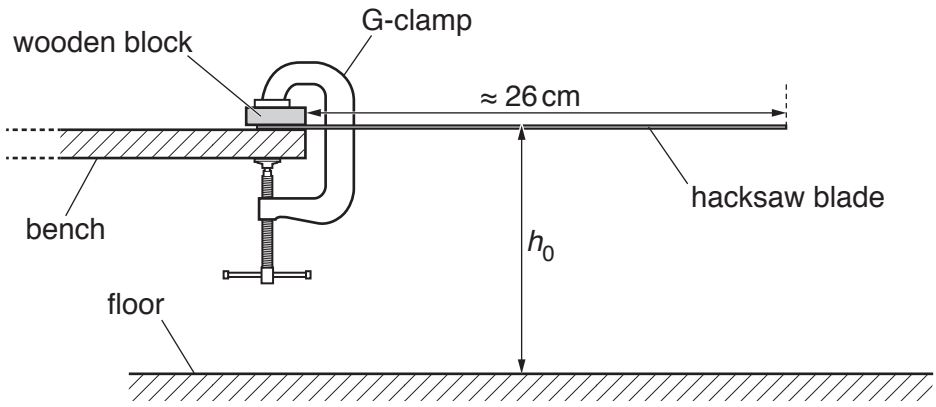


Fig. 2.1 (not to scale)

• The vertical distance from the floor to the top surface of the hacksaw blade is h_0, as shown in Fig. 2.1.

Measure and record h_0.

h_0 = ... [1]

(b) (i) • Place the 100 g mass on the blade with its centre approximately 19 cm from the bench and tape it in position.

When released, the hacksaw blade will bend down, as shown in Fig. 2.2.

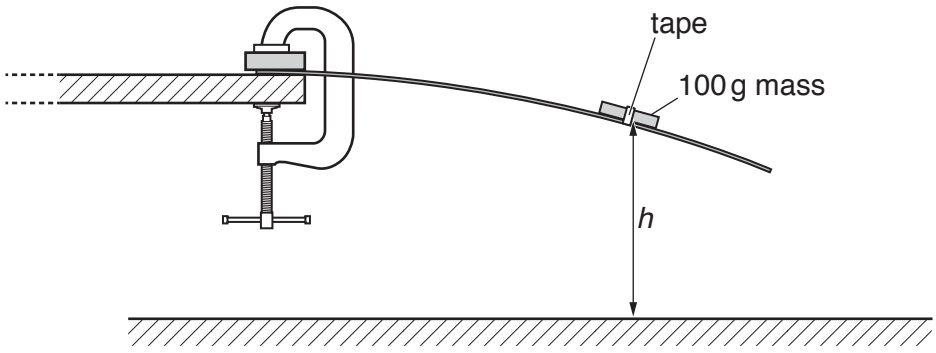


Fig. 2.2 (not to scale)

• The vertical distance from the floor to the top surface of the hacksaw blade at the centre of the mass is h.

Measure and record h.

h = ... [1]

(ii) Calculate y, where $y = h_0 - h$.

$y =$ ..... [1]

(c) Estimate the percentage uncertainty in your value of y.

percentage uncertainty = ... [1]

(d) Push the end of the hacksaw blade down a small distance and then release it. The blade will oscillate.

Determine the period T of the oscillations.

$T =$ ..... [2]

(e)
- Move the slotted mass approximately 3 cm further from the bench and fix it with tape.
- Measure and record h.

$h =$ .....

- Repeat **(b)(ii)** and **(d)**.

$y =$ .....

$T =$ .....
[3]

(f) It is suggested that the relationship between T and y is

$$T = c\sqrt{y}$$

where c is a constant.

(i) Using your data, calculate two values of c.

first value of c = ...

second value of c = ...
[1]

(ii) Explain whether your results support the suggested relationship.

.....

.....

..... [1]

(g) Theory suggests that an approximate value of the acceleration of free fall g is given by

$$g = \frac{4\pi^2}{c^2}.$$

Using your second value of c, calculate g.
Give an appropriate unit.

g = ... [1]

(h) (i) Describe four sources of uncertainty or limitations of the procedure for this experiment.

1. .....

.....

2. .....

.....

3. .....

.....

4. .....

.....

[4]

(ii) Describe four improvements that could be made to this experiment. You may suggest the use of other apparatus or different procedures.

1. .....

.....

2. .....

.....

3. .....

.....

4. .....

.....

[4]

[Total: 20]